

WHAT IS CLAIMED:

1. A magnetoresistance effect element having a magnetoresistance effect due to a multilayered structure, said magnetoresistance effect element, comprising, magnetic layers and at least an intermediate layer of an insulating material, a semiconductor and an antiferromagnetic material against a magnetic field from said magnetic layers, wherein said intermediate layer is inserted between said magnetic layers to form a magnetoresistance effect multilayered structure, and said magnetoresistance effect multilayered structure is included with terminals at one end and the other end thereof so that a current is flowed in said intermediate layer when the current is flowed in said magnetoresistance effect multilayered structure in one direction.

2. A magnetoresistance effect element according to claim 1, wherein at least a part of said magnetoresistance effect structure is formed on a nonmagnetic metal.

3. A magnetoresistance effect element according to claim 2, wherein said terminals are formed with said magnetic layers of the magnetoresistance effect multilayered structure, respectively.

4. A magnetoresistance effect element according to claim 3, wherein said magnetoresistance effect structure has a ferromagnetic spin-dependent tunneling effect.

5. A magnetoresistance effect element according to claim 4, wherein said magnetoresistance effect structure is formed with three layers selected from one of 7 combinations, Ni layer/NiO layer/Co layer, Fe layer/Ge layer/Co layer, Al layer/Al<sub>2</sub>O<sub>3</sub> layer/Ni layer, Co-Al layer/Al<sub>2</sub>O<sub>3</sub> layer/Ni layer, Fe-C layer/SiO<sub>2</sub> layer/Fe-Ru layer, Fe-C layer/Al<sub>2</sub>O<sub>3</sub> layer/Co-Ni layer, and Fe-C layer/Al<sub>2</sub>O<sub>3</sub> layer/Fe-Ru layer.

6. A magnetoresistance effect element according to claim 1, wherein said magnetoresistance effect multilayered structure having said intermediate layer of said antiferromagnetic material is formed with an Fe layer and Cr layer.

7. A magnetoresistance effect element according to claim 1, wherein an exchange bias field from said antiferromagnetic material is applied to at least one of said magnetic layers.

8. A magnetoresistance effect element according to claim 1, wherein said intermediate layer is comprised of one

or more materials of a carbide, a boride, nitride, a phosphide, and a compound of group IIIB to Vb elements.

9. A magnetoresistance effect element according to claim 1, wherein said magnetoresistance effect multilayered structure has a plurality of magnetoresistance effect multilayered structures connected.

10. A magnetoresistance effect element according to claim 1, wherein said magnetoresistance effect multilayered structure is formed on a substrate so that electrons are passed zigzag in said intermediate layer formed to be equidistant from said substrate and at intervals.

11. A magnetic head formed of a magnetoresistance effect element having a magnetoresistance effect due to a multilayered structure, said magnetoresistance effect element, comprising, magnetic layers and at least an intermediate layer of an insulating material, a semiconductor and an antiferromagnetic material, wherein said intermediate layer is inserted between said magnetic layers to form a magnetoresistance effect multilayered structure, and said magnetoresistance effect multilayered structure is included with terminals at one end and the other end thereof so that a magnetic field due to an occurring ferromagnetic spin-dependent tunneling effect is changed in accordance with a

magnetic flux leaking from a magnetic recording medium when a current is flowed in said magnetoresistance effect multilayered structure in one direction.

12. A magnetic head according to claim 11, wherein said terminals are formed with said magnetic layers of said magnetoresistance effect multilayered structure, respectively.

13. A magnetic head according to claim 11, wherein said magnetoresistance effect multilayered structure has two magnetic layers of different coercive forces formed on both sides of said intermediate layer of said insulating material, respectively.

14. A magnetic head according to claim 13, wherein said two magnetic layers are comprised of soft and hard magnetic materials.

15. A magnetic head according to claim 13, wherein the easy axis directions of said two magnetic layers formed on both sides of said intermediate layer of said insulating material are substantially perpendicular to each other.

16. A magnetic head according to claim 13, wherein the difference between the work functions of said two magnetic layers is 0.3 eV or above.

17. A magnetic head according to claim 11, wherein the thickness of said intermediate layer is in a range from 0.5 to 1.0 nm.

18. A magnetic head according to claim 13, wherein said two magnetic layers formed on both sides of said intermediate layer of said insulating material are shielded in their outer sides by a shielding material.

19. A magnetic head according to claim 11, further included with a magnetic pole for recording.

20. A magnetic head according to claim 11, wherein said magnetic head is formed on an induction type thin-film head.

21. A magnetic storage apparatus including a magnetoresistance effect element including a magnetoresistance effect due to a multilayered structure and forming with magnetic layers and an intermediate layer of an insulating material, a semiconductor and an antiferromagnetic material, wherein said intermediate layer is inserted between said magnetic layers to form a magnetoresistance effect multilayered structure, and said magnetoresistance effect multilayered structure is included with terminals at one end and the other end thereof so that a current is flowed in said intermediate layer when the current is flowed in said magnetoresistance effect multilayered structure in one

direction, the detection being composed of magnetic flux leaking from a magnetic recording medium so as to read information.

22. A magnetic recording and reproducing apparatus according to claim 21, wherein said terminals in said magnetoresistance effect element are respectively formed on one end and the other end of said magnetic layers constituting said magnetoresistance effect multilayered structure.